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RESEARCH REPORT

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Tariff Reduction, Carbon Emissions, And Poverty: An Economy-Wide Assessment for the Philippines

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This study investigates the potential impact of a carbon tax on the economy of the Philippines and on the livelihood of its people. It focuses on the interaction between such a tax and the country's ongoing trade liberalization programme. With energy use on the rise in the Philippines, increases in greenhouse gas emissions are almost inevitable. The policy most widely recommended by economists – a carbon tax – may be an efficient way to deal with the problem, but there is concern about its distributional effects.

The study finds that a carbon tax would compensate for any tariff revenues lost through a reduction in trade tariffs. It also finds that the tax would reduce poverty and increase people's welfare. Imposing a carbon tax during the ongoing trade liberalization process – provided the carbon tax is used to reduce income taxes – is a sensible approach that could meet the country's economic, environmental and equity objectives.

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Tariff Reductions, Carbon Emissions, and Poverty: An Economy-Wide Assessment of the Philippines

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February, 2007

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TARIFF REDUCTIONS, CARBON EMISSIONS, AND POVERTY: AN ECONOMY-WIDE ASSESSMENT OF THE PHILIPPINES

Erwin L. Corong

ABSTRACT

This study analyzes the economic and poverty impacts of reducing carbon emissions in the Philippines during the ongoing trade liberalization process. Simulation results indicate that tariff reductions reduce the cost of imported inputs thereby benefiting the outward-oriented and import-dependent manufacturing sector. However, tariff reductions reduce the cost of imported fossil fuels resulting in a marginal increase in carbon emissions. The economic cost of reducing carbon emissions by imposing a 100 peso carbon tax during the trade liberalization process is minimal. This is because the reduction in consumer prices as a result of tariff reductions outweighs the increase in production cost from the imposition of the carbon tax. The national poverty headcount falls as a result of tariff reductions. Moreover, the national poverty headcount decrease additionally, albeit marginally whenever the generated carbon tax revenue is recycled back to the economy—especially when used to reduce direct income taxes imposed among households rather than on reducing indirect taxes on goods and services.

1. INTRODUCTION

The Philippine government, during the 1992 Earth Summit, pledged to undertake policies to promote sustainable development in line with the Global 21 Agenda.[1] With this, the country (a) signed the United Nations Framework on Climate change (UNFCC) in 1992; (b) created the Philippine Council for Sustainable Development in 1996; and (c) signed the Kyoto Protocol in 1998. By October 2003, the Philippine Congress ratified the Kyoto Protocol, paving the way for the creation of a Greenhouse Gas National Action Plan (GHG-NAP).[2] As stipulated in Section 31 of the Philippine Clean Air Act of 1999, the GHG-NAP must be consistent with the UNFCC and Kyoto Protocol in order to implement, evaluate and monitor greenhouse gas reductions in the country.[3]

Demand for energy in the Philippines has been increasing since the last decade. Moreover, energy utilization primarily through the combustion of fossil fuels is expected to grow by 62 per cent from 2003 to 2012 (Philippine Energy Plan 2003). With this, the country's fossil fuel-related carbon dioxide emissions are expected to increase by more than fifty per cent within the next ten years.

This study assesses the economic and poverty impacts of reducing carbon emissions during the ongoing trade liberalization process in the Philippines by using the

[1] "Attempts to find balance between development fueled by the rapid integration of nations into the world economy and the impacts of this process on the environment and society." (Earth Summit 1992)
[2] As at January 2007, the said action plan is still being drafted.
[3] Although the Philippines is a signatory to the Kyoto Protocol, it is under no binding legal commitment to reduce greenhouse gas emissions during the commitment period 2008-2012, being a non-Annex I country.

latest available data of the Philippine economy.[4] A 35-sector static Computable General Equilibrium[5] (CGE) model linked to a household survey with 39,041 households was employed to simulate the impact of reducing carbon emissions under a liberalized economy. Four policy experiments were undertaken to investigate the following questions: (1) Have tariff reduction measures undertaken between the years 2000 and 2006 resulted in higher carbon emissions for the Philippines? (2) Will the imposition of a carbon tax to restrain carbon emissions be favorable or harmful to firms, households and the government? (3) Are there significant resource reallocation effects that may lead to changes in government finances, household income, consumer prices and poverty structure?

Furthermore, this paper implicitly investigates whether the imposition of a carbon tax in the Philippine economy may result in the so-called "double-dividend hypothesis", which states that imposing environmental taxes may provide not only a better environment (first dividend) but also bring about economic efficiency whenever environmental taxes are used to reduce other existing distortionary taxes in the economy (second dividend). Although the literature remains skeptical on the robustness of the hypothesis[6], Fullerton and Metcalf (1997) argue that its validity *"cannot logically be settled as a general manner" (P. 1, italics added)* since its achievement and benefits depends on current conditions as well policy reform being considered.

In line with this, two important considerations are worth noting with respect to the Philippine case. First, the Philippines like most developing economies has virtually inexistent environmental control on carbon emissions. Second and perhaps more important distinction is the tax structure which relies heavily on tariff revenue which accounts for roughly 20 per cent of total government revenue. While important from the government's revenue position, tariffs create additional distortions in the form of higher consumer prices which greatly affects the poor.

The experiments conducted in this paper were designed to capture the changing policy landscape in the Philippines. Initially, the economy-wide impacts of tariff reductions between the years 2000 and 2006 were assessed with the foregone tariff revenues being compensated by an increase in household direct income taxes as historical data on government's budget confirm this policy. This paper goes a bit further by exploring the possibility of imposing a 100 peso carbon tax owing to the increasing worldwide pressure, even among developing countries to reduce carbon emissions. In the same vein, the possibility of using the generated carbon tax revenue to offset the foregone tariff revenue and reduce other distortionary taxes (income tax imposed on households or indirect tax on goods and services) was likewise considered.

However, it should be noted that the model employed in this paper differ markedly from standard models that analyzed the "double-dividend" argument in the literature. Those models rely heavily on labor supply responses to real wages with

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[4] The database used is the constructed Social Accounting Matrix of the Philippines for the unofficial year 2000.

[5] A CGE model is an economic simulation model used for policy analysis. It models the whole economy. It is used to simulate the possible changes in a country's economy due to economic shocks or changes in government policy.

[6] This is because the imposition of environmental taxes may actually result in a negative second dividend

upward sloping labor supply curves[7] in contrast to this paper's model which assumes a neo-classical labor market structure with a vertical labor supply curve[8]—where labor supply equals labor demand with wages adjusting to yield full employment. Moreover, the representative households in this paper's model are assumed to behave via a Cobb-Douglas utility function without regard to environmental quality. This differs from the linear expenditure system (LES) utility function normally employed in the literature with environmental quality treated as part of household decisions and commodity consumption being weakly separable to leisure (see for example Bovenberg and Goulder 1996).

In spite of these differences, this paper embarks on an early attempt to analyze the economy-wide and poverty impact of carbon taxation in the Philippines. This study provides a different view by looking into the case of a small liberalized developing economy, in stark contrast to the "double dividend" literature which focused mostly on developed and mature-economies. This is an important distinction as the range of initial conditions differs among these countries significantly. Indeed, Coxhead (2000) argue that:

> "while a double dividend from environmental taxation can never be assured, *the range of conditions for its existence and efficacy in developing economies may be considerably broader than what the current literature appears to imply…that in industrializing economies, the greatest scope for improvements both in environmental quality and the efficiency of the tax system may arise from the imposition of explicit green taxes, but rather as a side-effect of the reform of the existing tax systems*". *(p. 1-2, italics added)*

The remaining sections are organized as follows: Section 2 presents a brief background of the research. Section 3 provides a survey of literature focusing on trade liberalization, poverty and environment in the Philippines while Section 4 introduces the CGE model, its assumptions, and parameters. Section 5 lays out the policy experiments and discusses the simulation results and sensitivity analyses. Finally, the concluding remarks are presented in Section 6.

2. BACKGROUND OF THE RESEARCH

2.1 Carbon Dioxide and Global Warming

The growing concern on global warming arising from the rapid accumulation of atmospheric greenhouse gases has, since the last decade, been part of the international policy agenda. In fact, the Kyoto Protocol (1998) was instituted in order to promote cooperative multilateral agreements aimed at controlling anthropogenic[9] greenhouse gas emissions. In addition, the Kyoto Protocol established binding reduction commitments on

[7] See Bovenberg and de Mooij (1994); Bovenberg and Goulder (1996); Fullerton and Mercalf 1997
[8] See Coxhead (2000) for a treatment of labor market with vertical labor supply curve in the Double Dividend literature
[9] The Inter-governmental Panel on Climate Change (IPCC, 2001a) defines "anthropogenic" as "resulting from or produced by human beings".

Annex I[10] countries, the initial implementation period being from 2008 to 2012 (Kyoto Protocol 1998).

The rationale behind the growing insistence on global greenhouse gas emission reduction, in spite of plausible future impacts, has been due to the increasing evidence of human-induced warming. Although natural variations contribute to the accumulation of greenhouse gases, recent scientific evidence shows that the observed warming in the last 50 years has been attributable to human activity (Intergovernmental Panel on Climate Change (IPCC) 2001a). Among the greenhouse gases, carbon dioxide (CO_2), the main anthropogenic greenhouse gas, has been identified as the foremost contributor to climate change. Carbon dioxide accounts for 60 per cent of the total change in greenhouse gas concentration in the last 50 years, hence contributing largely to the enhanced greenhouse effect (IPCC 2001a).

The combustion of fossil fuels, coupled with land use changes brought about by deforestation, has resulted in higher atmospheric greenhouse gas concentrations (mainly of CO_2) since the last century. Furthermore, the sustained economic dynamism of developed countries, as well as the continued industrialization of developing countries has greatly increased the amount of CO_2 emissions in the last decade. Because of this, worldwide CO_2 emissions arising from fossil fuel combustion alone was estimated at 23,172.20 million metric tons in 1999, representing an 8.9 per cent increase relative to 1990 levels (World Resources Institute (WRI) 2003). Although 64 per cent of these emissions originate from developed countries, the growing concern on the increasing share of developing countries' CO_2 emissions has been recognized. This is because developing countries are under no binding legal commitment to reduce their future CO_2 emissions. As such, it has been argued that a reduction agreement that does not include developing countries will achieve little gain (McKibbin and Wilcoxen 1999). The inclusion of developing countries in any reduction agreement is also necessary to prevent any carbon leakage[11] problem.

2.2 Background on Trade Policy in the Philippines

2.2.1 Trade Policy Environment (1945–1980) [12]

The balance-of-payments (BOP) crisis which transpired barely four years after the Second World War ended in 1945 greatly shaped the industrial and agricultural policy landscape of the Philippines. A high demand for imported goods to help resurrect the economy coupled with poor local production led to a decline in international reserves and the 1949 BOP crisis. This crisis spurred a policy response centered on import and foreign-exchange controls. Though initially intended to be short-lived, these policy responses soon became a prominent feature resulting in a development strategy geared towards industrial import substitution with lesser emphasis on the agricultural and export sectors.

[10] Developed countries and economies in transition. Refer to Kyoto Protocol (1998) for a complete list.
[11] Carbon leakage is a situation where CO_2 emission reductions undertaken by developed countries (or parties subject to emission reduction in the Kyoto Protocol may well be offset, or even surpassed by an increase in a developing country's emissions (or parties not subject to emission reduction).
[12] Discussion in this section is mainly based Cororaton and Corong (2006).

In 1957, a highly protective Tariff Code was implemented which reinforced the government's import-substitution policy by providing incentives to domestic producers of finished consumer goods. High tariff rates were imposed on non-essential consumer goods while low rates were applied to essential producer inputs. The presence of a highly skewed inter-sectoral tariff protection in favor of import-substituting manufactured goods created a strong bias against agriculture and exports. The weighted average Effective Protection Rates (EPR) of the manufacturing sector was 44 per cent in 1974, compared to a much lower nine per cent protection rate for agriculture and mining. Moreover, Tan (1979) revealed a highly skewed protection structure for exportable goods, which mainly consisted of agricultural products having a four per cent protection rate as opposed to 61 per cent for non-exportables. Moreover, consumption goods had a 77 per cent protection rate compared to 23 per cent and 18 per cent for intermediate and capital goods, respectively.

The impact of all these on agriculture was devastating. The policy bias towards import substitution and against agriculture and exports led to market distortions that promoted rent-seeking activities (a widely-used economic term to describe when someone tries to make more profit by manipulating the economic environment) and lower returns on investments in agriculture. Hence, the comparative advantage of the agricultural sector, which served as the country's backbone for the foreign exchange needed by the import-dependent manufacturing sector, became stagnated and eroded. On the other hand, the highly protected manufacturing sector, which hid behind the infant-industry shield, did not live up to its promise of becoming globally competitive. The almost-30 years of protection simply resulted in the sector venturing into import-dependent assembly-type operations with minimal value-added content and little or no forward and backward linkages.

Realizing the pitfalls of its import-substitution policy, the government initiated an outward-looking strategy geared towards export promotion. Spurred by the structural policy adjustments prescribed by multilateral agencies (World Bank and International Monetary Fund) in the late 1970s, the government started its Trade Reform Program (TRP) in 1981.

2.2.2 Philippine Trade Reform

The first phase of the TRP (TRP-1) started in the early 1980s with three major components: tariff reductions, an import-liberalization program, and the complementary realignment of indirect taxes. The maximum tariff rates were reduced from 100 to 50 per cent. Between 1983 and 1985, sales taxes on imports and locally-produced goods were equalized. The mark-up applied on the value of imports (for sales-tax valuation) was also reduced and eventually eliminated. The implementation of TRP-1 was suspended in the mid-1980s because of a BOP crisis but was resumed in 1986.

In 1991, the government launched TRP-2 to realign tariff rates over a five-year period. The realignment involved the narrowing of tariff rates through a series of reductions in the number of commodity lines with high tariffs and an increase in the number of commodity lines with low tariffs. The program was aimed at clustering tariff rates within the 10-30 per cent range by 1995. In 1992, a program to convert Quantitative

Restrictions (QRs) into tariff equivalents was initiated. In 1994, the Philippines became part of the World Trade Organization (WTO), and thereby committed to gradually removing QRs on sensitive agricultural product imports (products identified by the government as politically sensitive in nature), with the exception of rice, by switching towards tariff measures.

In 1995, TRP-3 started with the aim of adopting a uniform five per cent tariff rate by 2005. The overall program was designed to establish a four-tier tariff schedule: three per cent for raw materials and capital equipment not available locally; 10 per cent for raw materials and capital equipment available from local sources; 20 per cent for intermediate goods, and 30 per cent for finished goods. In 1996, the government implemented a tariff-quota system for sensitive agricultural products. The minimum-access-volume (MAV) provision was instituted in which a relatively low tariff rate was imposed upon imported sensitive agricultural products up to a minimum import level (in-quota tariff rate), while a higher tariff rate was levied beyond the minimum import level .

In 1998, TRP-4 was undertaken to recalibrate the tariff-rate schedules implemented under previous TRPs. This resulted from a tariff-review process that evaluated the pace of tariff reduction in line with the competitiveness of the local industry. With this, the planned uniform tariff rate was suspended. Overall, the various rounds of TRPs were beset by policy reversals due to economic and political reasons, particularly lobbying by interested groups (Aldaba 2005).

2.2.3 Trade Policy Environment (1981–2005)

The 1990s witnessed a reversal of protection towards agriculture coupled with accelerating manufacturing-sector liberalization. Nonetheless, studies have shown that: (a) the bias against exports and towards imports has not been addressed; (b) although tariff rates are low, the tariff structure is still distorted; (c) the reversal of protection towards agriculture, particularly on sensitive products, has constrained growth and efficiency in the agricultural sector (Aldaba 2005; Habito and Briones 2005).

The frequency distribution of tariff rates for the period 1980–2004 was within the 0-50 per cent range**,** with the applied nominal tariff rates for manufacturing already lower than the bound tariff rates[13] that the country committed to the WTO (Austria 2002) However, this **is** not the case for agriculture where nominal tariff rates, particularly on sensitive agricultural products, remain at 100 per cent within the bound tariff rates (Austria 2002).

An analysis of tariff peaks and the coefficients of variation[14] by Aldaba (2005) reveals that the tariff structure is heavily distorted. The tariff legislations enacted between 1998 and 2005 (including policy reversals) increased not only the tariff lines but more importantly, the percentage of tariff peaks and coefficients of variation. From 1988 to 2005, overall tariff peaks increased from 2.24 to 2.71 per cent while the overall coefficient of variation increased from 0.44 to 1.07 per cent. Similarly, this period reinforced the pro-agriculture bias as the sector's EPR stood at 15.09 per cent compared

[13] The bound tariff rate is the tariff level that a WTO-member country commits not to exceed.
[14] The tariff peak is the proportion of products with tariffs exceeding three times the mean tariff. The coefficient of variation is the ratio of the standard deviation to the mean.

to 5.13 for manufacturing, and the overall EPR of 6.33 per cent (Aldaba 2005). The tariff structure remained biased towards importables, penalizing exportable goods. For instance, food processing, which registered the highest EPR of 15.36 per cent, showed a bias towards importables, with 15.01 per cent compared to 0.35 per cent for exportables (Aldaba 2005).

However, the heavy protection afforded to agriculture has hampered its efficiency as Philippine farm-gate prices have become higher than most Asian countries (Habito and Briones 2005). In part, this can be explained by a 10.16 per cent EPR afforded to importable agricultural goods against a 4.93 per cent to exportables (Aldaba 2005).

2.3 Energy Utilization

2.3.1 Energy Mix

The demand for energy has been increasing since the last decade (Table 1), particularly between the years 1994 and 1997, which is a period characterized by high economic growth and massive investments in electricity generation in response to power shortages during the early 1990s. In spite of the economic downturn since the turn of the century and higher energy prices, energy utilization rose by 60 per cent from 122.5 to 196.2 million barrels of fuel oil equivalent (MBFOE) between the years 1991 and 2004. However, this has petered out in recent years, resulting in lower utilization levels currently.

Table 1. Energy Mix (in million barrels of fuel oil equivalent (MBFOE))

	1991	**1994**	**1997**	**2000**	**2003**
I. Conventional					
Oil	79.6	102.7	132.9	113.6	121.4
Natural Gas	0.0	0.0	0.02	0.03	17.1
Coal	8.5	8.8	15.9	28.7	27.3
Hydro-power	8.9	10.1	10.5	13.5	13.6
Geothermal Power	9.9	10.9	12.5	20.1	16.9
II. Non-Conventional					
Bagasse	6.1	5.2	9.7	10.7	0.0
Agriwaste	9.0	8.3	59.9	64.2	0.0
Others	0.4	0.6	0.3	0.2	0.0
Total Energy	**122.5**	**146.5**	**241.7**	**250.9**	**196.2**
Self Sufficiency (%)	**33.2**	**28.8**	**40.2**	**45.2**	**50.4**

Source: Philippine Energy Plan 2005

Within the energy mix, fossil fuels accounted for at least 60% of total energy use. Oil remained as the major source of energy in spite of its reduced share in the total energy mix, whereas the share of natural gas increased as the Malampaya gas field became operational in 2003. Notably, coal utilization grew by 221 per cent ({(27.3/8.5) - 1]*100 = 221} from 8.5 to 27.3 million barrels of fuel oil equivalent between 1991 and 2003 due to the increase in the number of coal-fired power plants and higher demand of the local cement industry (PEP 2005). Hence, coal's share in the total energy mix doubled from 7 to 14 per cent between 1991 and 2003.[15]

The share of non-conventional energy from the energy mix increased from 13 per cent in 1991 to 30 per cent in the year 2000.[16] Though its share remained minimal, the rise in the usage of non-conventional energy, together with the higher production of indigenous sources[17], particularly natural gas production, helped the country achieve a 50 per cent self-sufficiency level by the year 2003.

Table 2. Energy-Economy Parameters

	1991	**1994**	**1997**	**2000**	**2003**
GDP (in billion pesos)	716.5	766.4	892.9	953.6	1,093.3
Growth Rate (in per cent)	-0.6	4.4	5.2	4.0	4.5
ENERGY (in MBFOE)	122.5	146.5	241.7	250.9	259.8
Growth Rate	1.6	7.1	8.5	2.2	2.2
ELASTICITY					
Energy to GDP	-2.7	1.6	1.6	0.5	0.5
INTENSITY					
Energy to GDP (BFOE per 10,000 peso output)	1.7	1.9	2.7	2.6	2.4

Source: Philippine Energy Plan 2005

Table 2 shows the relative energy intensity of the Philippine economy. Energy intensity[18] — which is the ratio of absolute energy consumption to the Gross Domestic Product (GDP) — increased from 1.7 barrels of fuel oil (BFOE) per ten thousand peso output in 1991 to 2.4 BFOE in 2003, suggesting that past economic activity was stimulated by higher energy utilization. Similarly, the energy to GDP elasticity which measures the change in energy consumption for every unit change in real GDP increased

[15] Coal's share in the energy mix is derived by taking the ratio of coal demand to the total energy mix in a given year. In 1991, coal's share [(8.5/122.5)*100] is equal to 7 per cent, while it is roughly 14 per cent [(27.3/196.2)*100] in 2003.

[16] These figures were calculated by summing up all non-conventional energy divided by total energy in 1991 and 2003.

[17] Indigenous sources refer to locally-sourced energy such as oil, coal, natural gas, hydro, and geothermal energy.

[18] Energy intensity reveals the relationship between energy use and economic activity.

from -2.7 per cent to 0.5 per cent between 1991 and 2003. Although the energy to GDP elasticity reached its peak of 1.6 per cent in 1994 and 1997, it decreased to 0.5 thereafter as a result of efficiency improvements from the increased utilization of natural gas (PEP 2005).

2.3.2 Energy Demand Forecast

Projections by the Department of Energy (DOE) indicate that the rising energy intensity of the economy will continue as energy utilization has been expected to grow by 5.5 per cent a year from 2003 to 2013 in order to complement the 5.4 per cent annual GDP growth target. In absolute terms, the country's energy requirement will increase from 268 in 2003 to 433 MBFOE by 2012, representing a 62% growth spread over a ten-year horizon (PEP 2003). See Table 3.

Table 3. Projected Energy Mix (in MBFOE)

Energy Type	2003	2004	2005	2006	2007	2012
I. Conventional						
Oil	107.37	112.73	116.99	123.58	133.81	177.68
Natural Gas	16.86	19.39	20.65	21.67	22.84	26.19
Coal	28.34	27.36	29.20	35.68	37.95	40.28
Hydro-power	10.57	11.52	13.24	13.27	13.31	13.44
Geothermal Power	23.53	24.96	25.09	25.15	25.16	25.17
II. Non-Conventional						
Fuel Wood	45.68	47.03	48.05	48.95	50.03	55.68
Bagasse	11.52	11.81	12.11	12.41	12.71	14.14
Charcoal	5.48	5.85	5.88	5.83	5.93	6.41
Agri-Waste	18.25	19.02	19.61	20.20	20.79	24.88
Other Renewable	0.57	0.60	1.06	1.64	1.68	2.97
Others	0.00	0.00	1.38	1.24	2.33	46.48
Total	**268.16**	**280.27**	**293.24**	**309.63**	**326.56**	**433.31**

Source: Philippine Energy Plan 2003

The projected increase in demand for fossil fuel between 2003 and 2012 will significantly outpace all other energy sources, notably natural gas and coal (Figure 1). Overall, oil will continue to be the major source of energy, although its growth rate remains at roughly five per cent.

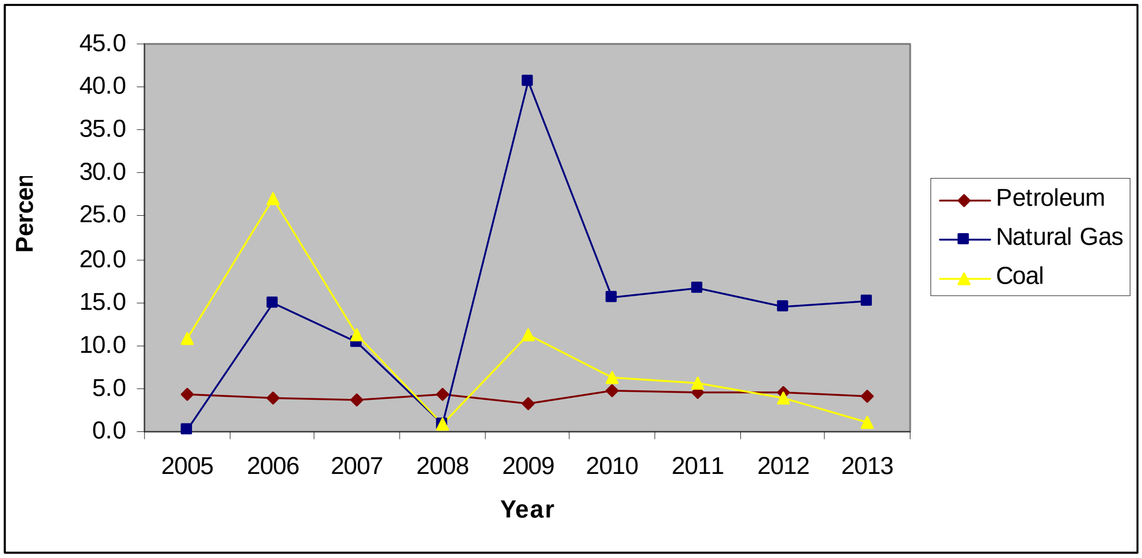


Figure 1. Projected Increase in Demand (Petroleum, Coal, Natural Gas)

Source: Philippine Energy Plan 2005

2.4 Carbon Emissions

The increased energy dependence of the economy since the last decade has resulted in a significant increase in Philippine CO_2 emissions so much so that by 1998, the country discharged 75,988 thousand metric tons of CO_2 into the atmosphere from fossil fuel combustion alone. This amount represents a 72 per cent increase relative to 1990 levels (WRI 2003). As shown in Table 4, emissions mainly originate from the combustion of fossil fuels (both solid and liquid fuels) and cement manufacturing.

Figure 2 illustrates the sectoral CO_2 emissions share in 1999 where transportation, electricity, and manufacturing sectors account for a combined share of 80 per cent whereas the group "other sectors", together with other energy industries and the residential sector, contributes the remaining 20 per cent share.

On the other hand, projections by the Department of Energy (DOE) indicate that the CO_2 emissions will continually increase due to the rising fossil fuel demand of the Philippine economy (Table 5). In fact, the cumulative fossil fuel emission is expected to increase by 53 per cent ((124/81.3) - 1)*100 = 52.5%) within the next eight years. Due to its dominance in the energy mix, oil-related CO_2 emissions are expected to account for at least 65.8 per cent. Nevertheless, three things are worth pointing out. Firstly, there will be a dramatic increase in natural gas CO_2 emissions owing to its increased utilization in the electricity sector. Secondly, there will be slight variations in coal-related CO_2 emissions emanating from the closure and construction of coal-fired power plants in the next few years. Thirdly, almost 90% of the total future CO_2 emissions in the country will come mainly from the energy sector (PEP 2005).

Table 4. Philippine Carbon Dioxide (CO_2) Emissions[a] (in thousand metric tons of CO_2)

Total emissions, 1998	75,988
Per cent Change since 1990	72%
Emissions as a per cent of global CO_2 production	0.3%
Emissions in 1998 From	
Solid fuels	13,612
Liquid fuels	55,729
Gaseous fuels	0
Gas flaring	0
Cement manufacturing	6,646
Per capita CO_2 emissions, 1998	1.0
Per cent change since 1990	40%
CO_2 emissions (in metric tons) per million dollars Gross Domestic Product, 1998	925
Per cent change since 1990	39%
Cumulative CO_2 emissions 1990-1999 (in billion metric tons)	1,399

Source: World Resource Institute 2003

Note: [a] Only fossil fuel-related emissions

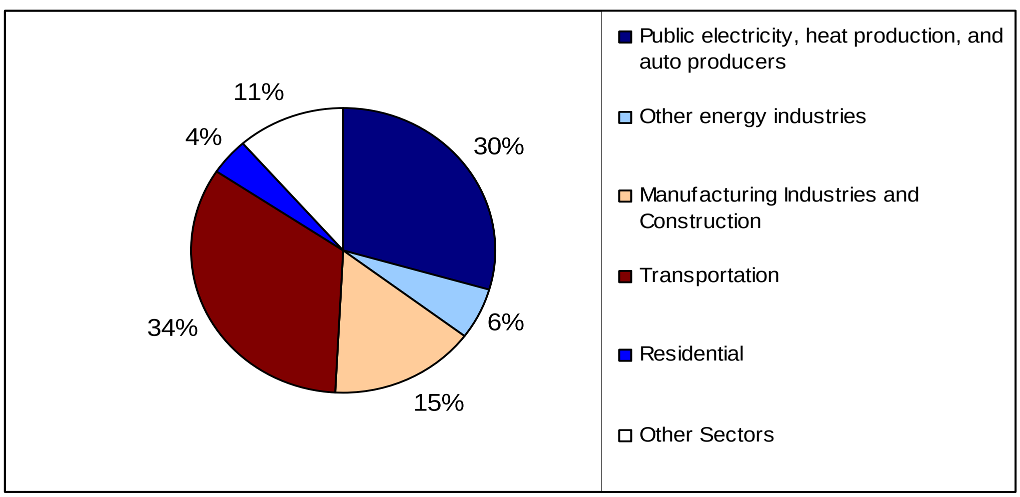


Figure 2. Sectoral CO_2 emissions (1999)

Source: World Resource Institute 2003

Table 5. Projected Carbon Dioxide (CO_2) Emissions from Energy Use
(in million tons MMT)

	2006	2008	2010	2012	2014
Coal	18.8	26.6	29.8	33.5	35.2
Oil and Oil Products	54.1	56.3	53.2	60.2	65.8
Natural Gas	8.3	10.1	16.0	18.4	23.2
Total	**81.3**	**92.9**	**99.0**	**112.1**	**124.2**

Source: Philippine Energy Plan 2005

2.5 Poverty and Inequality

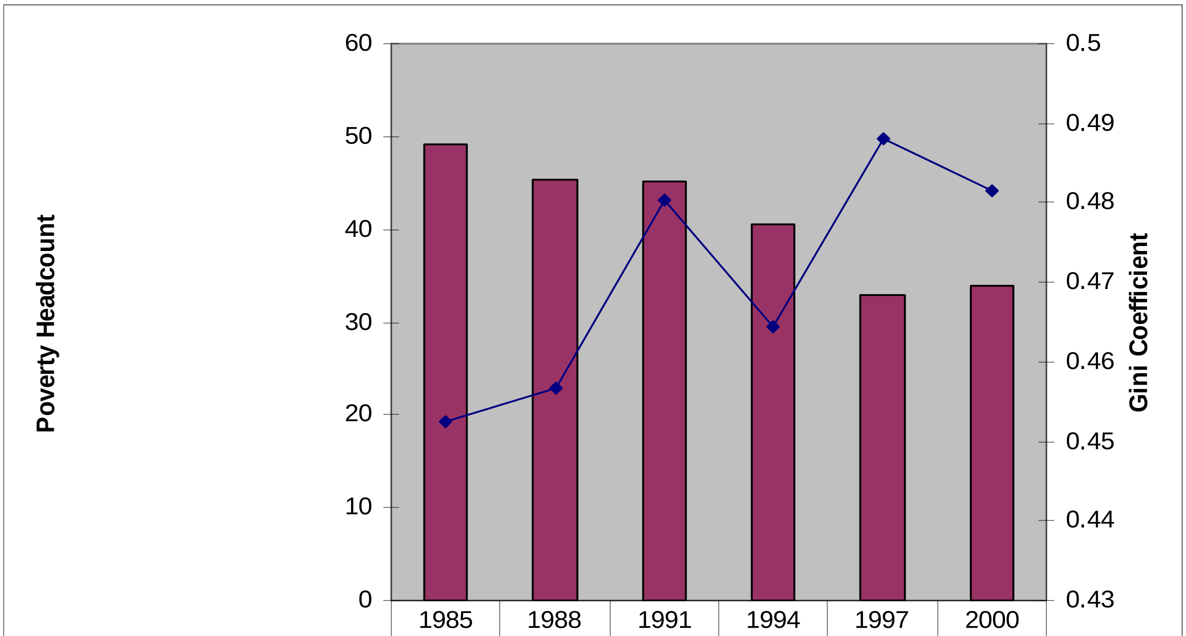
Widespread poverty and the persistence of income inequality have been endemic since the post-war era (Balisacan 1996). Although various government policies to address these concerns have been implemented, the extent of poverty reduction over the last three decades has however been so gradual, that by the turn of the century, the Philippines recorded the highest incidence of absolute poverty compared with other East Asian Economies (Balisacan 2003).

Poverty is fundamentally a rural problem. Almost half of the rural population lived below the poverty line in the year 2000. This is in stark contrast to those in the urban areas where poverty involves only a fifth of the population. Figure 3 presents the evolution of the poverty-headcount index and the Gini coefficient (which measures the degree of income inequality) from 1985 to 2000. The poverty-headcount index dropped continuously from 49.2 per cent in 1985 to 33 per cent in 1997 but then worsened to 34 per cent in 2000 as a result of the 1998 El Niño phenomenon and the Asian financial crisis.[19] On the other hand, income inequality steadily increased over this period as the Gini coefficient worsened from 0.45 in 1985 to 0.48 in 2000.

An equally important consideration in assessing poverty and inequality in the Philippines is the peculiar but commonly held notion within policy dialogues about the their nature and causes as well as factors that affect them. Firstly, it is widely argued that economic growth does not benefit the poor because of the absence of the trickle-down effect. Secondly, it is inherently believed that the inter-spatial and inter-sectoral dimensions of regional and employment disparity contribute largely to poverty and inequality. These obscure notions were, however, exposed by Balisacan (2003) as not entirely legitimate since (a) past episodes of economic growth indeed contributed to poverty reduction; and (b) intra-spatial together with intra-sectoral, rather than inter-spatial and inter-sectoral dimensions, contributed largely to the causes of poverty and inequality in the Philippines. That is, “within-region” rather than “between-region”

[19] The poverty headcount in 1997 and 2000 were 36.9 and 39.5 per cent respectively (NSCB, 2005). The lower poverty incidence cited here was due to a change in methodology by the National Statistical Coordination Board. See Hwww.nscb.gov.phH for details.

inequality arising from differences in physical possession and human assets is the foremost reason for inequality in the Philippines (Balisacan 2003). Thus, the divergence in welfare levels within sectors and not between sectors accounts for the variation in national household welfare.



	1985	1988	1991	1994	1997	2000
Poverty Headcount	49.2	45.4	45.2	40.6	33	34
Gini	0.4525	0.4568	0.4803	0.4644	0.4881	0.4814

Figure 3. Income Distribution and Poverty in the Philippines (1985 - 2000)

Source: Family Income and Expenditure Survey, NSCB (various years)

Cororaton and Corong (2006) employed an integrated computable general equilibrium micro-simulation model to analyze the impact of tariff reductions on poverty. Their findings suggest that poverty in the Philippines is sensitive to three factors. The first is spatial consideration – rural households are worse off compared with their urban counterparts because of limited economic activity in the rural sector. The second factor is human capital – highly-educated household heads benefit the most from tariff reductions because of their ability to move towards sectors offering higher returns. The third element is household head – female-headed households respond better to trade liberalization compared with their male-headed counterparts because of the expansion in semiconductors, textile and garments, and wholesale and retail trade sub-sectors which employ mainly highly-educated/skilled female workers.

3. SURVEY OF LITERATURE

Thus far, only a few applied general equilibrium models have been utilized to analyze the link between the economy and the environment in the Philippines. Aldaba and Cororaton (2002) utilized a Computable General Equilibrium (CGE) Model to analyze the pollution impacts of trade liberalization in the 1990's. Their findings revealed that the pollution effects of trade liberalization were relatively small as carbon monoxide (CO) increased marginally by 0.05 per cent between the years 1994 and 2000. Coxhead and Jayasuriya (2004) analyzed the potential economic, poverty and environmental effects of trade liberalization in the Philippines using the Agricultural Policy Experiments (APEX) Model (Clarete and Warr 1992) model. Although APEX has no explicit environmental linkage, the authors were able to infer the probable environmental impacts of trade liberalization using "detailed prediction of input and output changes". However, the impacts of trade liberalization on CO_2 emissions were not analyzed.

There are various ways by which carbon emissions can be restricted. However, reducing carbon emissions through carbon taxes rather than energy taxes is preferred as the latter is consistent with the economic efficiency point of view being a tax on the externality itself. Furthermore, it has been well documented that energy taxes result in larger economic costs than carbon taxes (Zhang 1998).

Economic theory suggests that the optimal carbon tax should be set at the point where the marginal social cost of reducing CO_2 emissions is equal to the marginal social benefits. That is, under a first best setting, the least cost solution is to impose a Pigouvian tax (a tax on pollution) that is equal to the marginal cost of damages (Baumol and Oates 1988). This suggests that an optimal carbon tax would ensure that the Marginal Cost of Public Funds (MCPF)[20] is equal to unity implying that the cost of public funds is lower than private funds (Bovenberg and Goulder 1996).

However, under a second best setting where distortionary taxes are present, the optimality of the carbon tax depends on the response of labor supply to the real after tax wage[21] (Bovenberg and de Mooij 1994). If, for instance the uncompensated wage elasticity of labor supply is positive, imposing a carbon tax leads to a fall in the real wage (after tax) resulting in decreased employment brought about by reduced incentives to supply labor. Hence, the MCPF would be greater than unity[22] since the carbon tax exacerbates the distortions imposed by the labor tax further eroding the tax base. Therefore, the carbon tax should be set below the optimal Pigouvian level in order to equate marginal welfare costs with marginal social (environmental) benefits (Bovenberg and de Mooij 1994; Bovenberg and Goulder 1996).[23]

[20] MCPF = Marginal utility (value) of public revenue divided by the marginal utility of private income
[21] Assuming labor taxes are positive.
[22] Whenever the uncompensated wage elasticity of labor supply and labor taxes are both positive.
[23] They have shown that the carbon tax may even be negative if revenues are given back to households in a lump sum manner. Recycling revenues in a lump sum manner implies that all households stand to receive equal amounts of revenue share from the carbon tax regardless of income class.

In spite of this, a cost reduction may still be achieved by using the revenues generated from the carbon tax. Hence, the 'double dividend' argument which states that environmental taxes can both reduce pollution and economic costs associated with the tax system may still be possible if the generated carbon tax is used to reduce distortionary taxes rather than be returned in a lump-sum manner (Bovenberg and de Mooij, 1994; Bovenberg and Goulder 1996).

The debate on the double dividend hypothesis has centered on validating whether the second dividend (that is, using environmental taxes to reduce other distortionary taxes in the economy to enhance economic efficiency) exists. However, most studies found that, assuming an upward sloping labor supply curve, imposing environmental taxes exacerbates the distortions imposed by the labor tax. That is, environmental taxes generally leads to a fall in the real wage (after tax) resulting in decreased employment brought about by reduced incentives to supply labor, which then erodes the base of the labor tax. With this, labor tax must be increased if revenue neutrality is to be ensured.

Nonetheless, these studies focused mainly on developed and mature-economies where the tax system is not as economically distorting when compared with developing countries. In reality, the range of conditions among developed and developing countries differ significantly. Coxhead (2000) argued that although a double dividend from imposing environmental taxes can never be assured, the range of optimism among developing countries is higher owing to possible improvements in the efficiency of the tax system which may result as a "side-effect" from the imposition of environmental taxes.

Fullerton and Metcalf (1997) made a comprehensive review of the double dividend literature. They posited that much of the skepticism surrounding the issue arose from the literature's failure to address two important questions: *"(a) what are the existing policies in place before the reform? (b) what exactly is the reform?, leaving the hypothesis inadequately specified" (page 2, italics added).* Thus, they argued that the validity of the double dividend hypothesis "*cannot logically be settled as a general manner" (P. 1, italics added)* since its achievement and benefits depends on current conditions as well policy reform being considered.

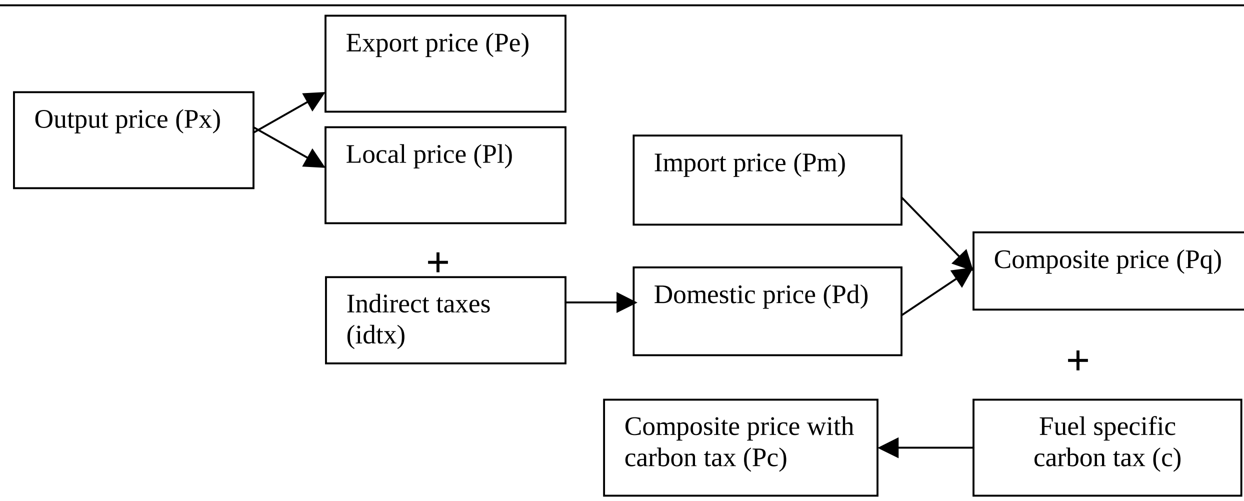
4. THE MODEL

The study employs a static CGE macro-micro model to assess the economic and poverty impacts of carbon tax under a liberalized economy. The imposition of a carbon tax to control carbon emissions will lead to changes in relative energy prices, which will then result in changes in the relative prices of goods and services, thus altering the production and economic structure. In turn, the changes in relative prices coupled with changes in economic structure will alter household incomes and consumptions patterns. Thus, the use of an economy-wide model is appropriate since it fully accounts for economic feedback emanating from environmental policies.

4.1 Basic Structure of the Model

Figure 4 presents the basic price and volume relationships within the model. On the supply side, Output (X) is specified as a Constant Elasticity of Transformation (CET) function between Export (E) and Domestic Sales (D). The allocation between Exports and Domestic Sales depends on the export price (Pe), local price (Pl) and the elasticity of substitution. For instance, if the price of exports increases relative to the local price, then the export supply will increase while the supply for domestic sales will decline. The magnitude of reallocation, however, will depend upon the elasticity of substitution.

The demand side is specified as a Constant Elasticity of Substitution (CES) function between imports (M) and domestic goods (D). This is otherwise known as the Armington or small country assumption to account for product differentiation between imported and domestically produced goods. The allocation between imports and domestic goods depends on the import price (Pm), domestic price (Pd) and the elasticity of substitution. That is, if the price of imports decreases relative to the domestic price, then the demand for imports will rise relative to domestic goods. The magnitude of reallocation depends on the elasticity of substitution.



Prices:

Domestic export price: $Pe = Pwe \cdot er$ — where: Pwe – world export price; er – exchange rate

Output price: $Px = (Pe \cdot E + Pl \cdot D)/X$ — where: Pl – local producer price for domestic sales; E – exports; D – Domestic goods

Domestic Consumer Price: $Pd = Pl \cdot (1+itxr)$ — where: itxr – indirect tax rate

Import Price: $Pm = Pwm \cdot er \cdot (1+tm) \cdot (1+itxr)$ — where: Pwm – world import price; tm – tariff rate

Composite Price: $Pq = (Pd \cdot D + Pm \cdot M)/Q$ — where: M – imports; Q – composite commodity

Composite Price with Carbon: $Pc = Pq \cdot (1+ctxr_j)$ — where: $ctxr_j$ – carbon specific advalorem tax rate for fuel j

Figure 4. Basic Price Relationships in the CGE Model

The supply side of the model assumes profit maximization while the demand side assumes cost minimization. Thus, the first order conditions (this is a mathematical/operations research term which means deriving the optimum value) on the supply side generate the necessary supply and input demand functions while the first order conditions on the demand side provides the necessary import and domestic demand functions.

With respect to prices, Output price (Px) is determined as a composite price of exports (Pe) and local prices (Pl). Adding indirect taxes to local prices then determines the domestic price (Pd), which when combined with the import price (Pm) results in the composite price (Pq). The import price (Pm) is in domestic currency, which is affected by the world price of imports (Pwm), exchange rate (er), tariff rate (tm), and indirect tax rate (idtx). The direct effect of tariff reductions for instance will result in a reduction in Pm, which if significant enough will lead to a decline in the composite price (Pq). Finally, multiplying Pq by the carbon specific advalorem (this means based on value and not per unit) tax rate for fuel results in the final composite price with carbon tax (Pc).

4.2 Production Classification

The model is a non-linear static CGE calibrated to the year 2000 Philippine Social Accounting Matrix (SAM). There are 35 producing sectors in the model, composed of 10 agricultural and 19 manufacturing sectors which includes six energy sectors (oil, coal, natural gas, electricity, hydro, and geothermal), and six service sectors including public services. There is sector-specific capital[24] and four labor types classified according to educational attainment: (1) unskilled; (2) semi-skilled; (3) skilled; and (4) professional.

It is assumed that all sectors produce tradable goods except the government that produces a non-tradable good; government services. The nested production structure for non-electricity sectors and the electricity sector are depicted in Figures 5a and 5b respectively. It shows the interdependence between input and output and how each sector's output is produced in the model, assuming constant returns to scale

Figure 5a presents the nested production structure of non-electricity sectors (assuming constant returns to scale). Gross output is determined via a four-stage process. The first stage involves the optimal determination energy input through Cobb-Douglas (CD) aggregation. In the second stage, the aggregated labor input is combined with capital to form a capital-labor composite using Constant Elasticity of Substitution (CES) aggregation. Then, the capital-labor and energy bundle is combined through CES aggregation in the third stage. Gross output is produced through a Leontief function of intermediate inputs, energy bundle, and the capital-labor bundle.

Similarly, Figure 5b sketches out the production structure of the electricity sector. It is essentially similar to the production technology of the non-electricity sectors. The main difference, however, lies in the additional inputs in the form of geothermal and hydro-power used in the production of electricity.

[24] Sector-specific capital refers to capital that is not movable across sectors.

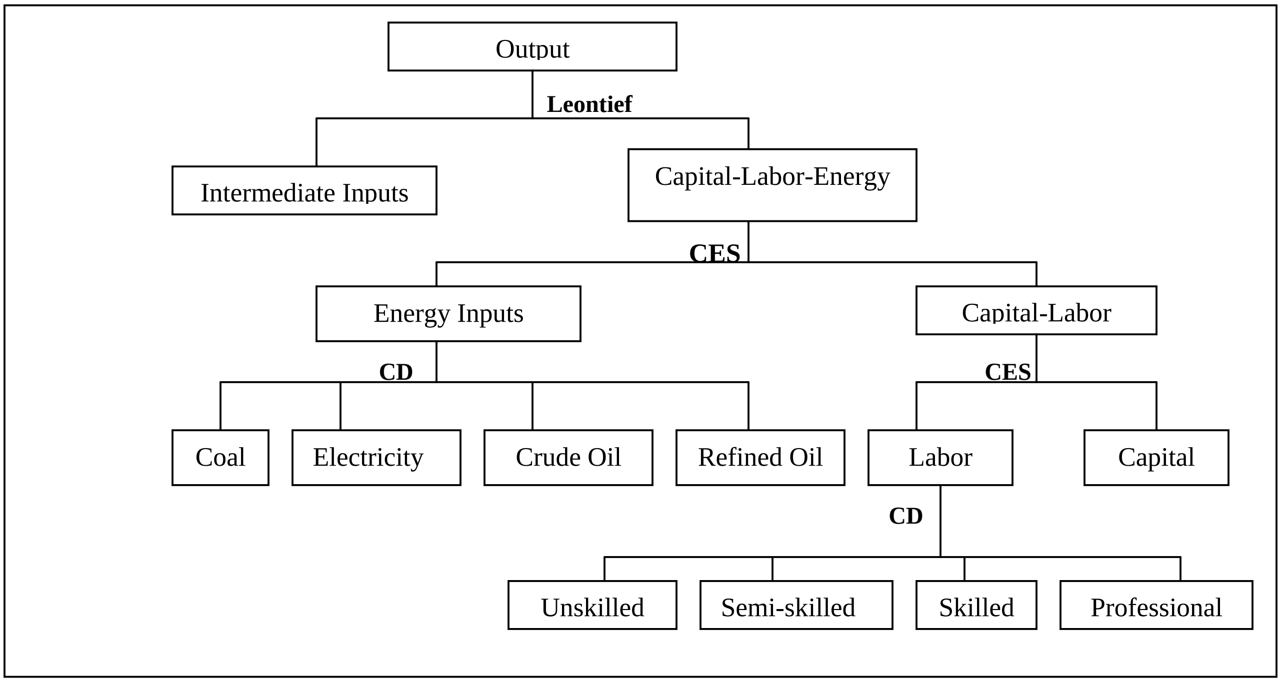


Figure 5a. Production Structure of Non-Electricity Sectors

Notes:

a) Leontief = Leontief function or Fixed Input coefficients

b) CES =Constant Elasticity of Substitution

c) CD = Cobb-Douglas

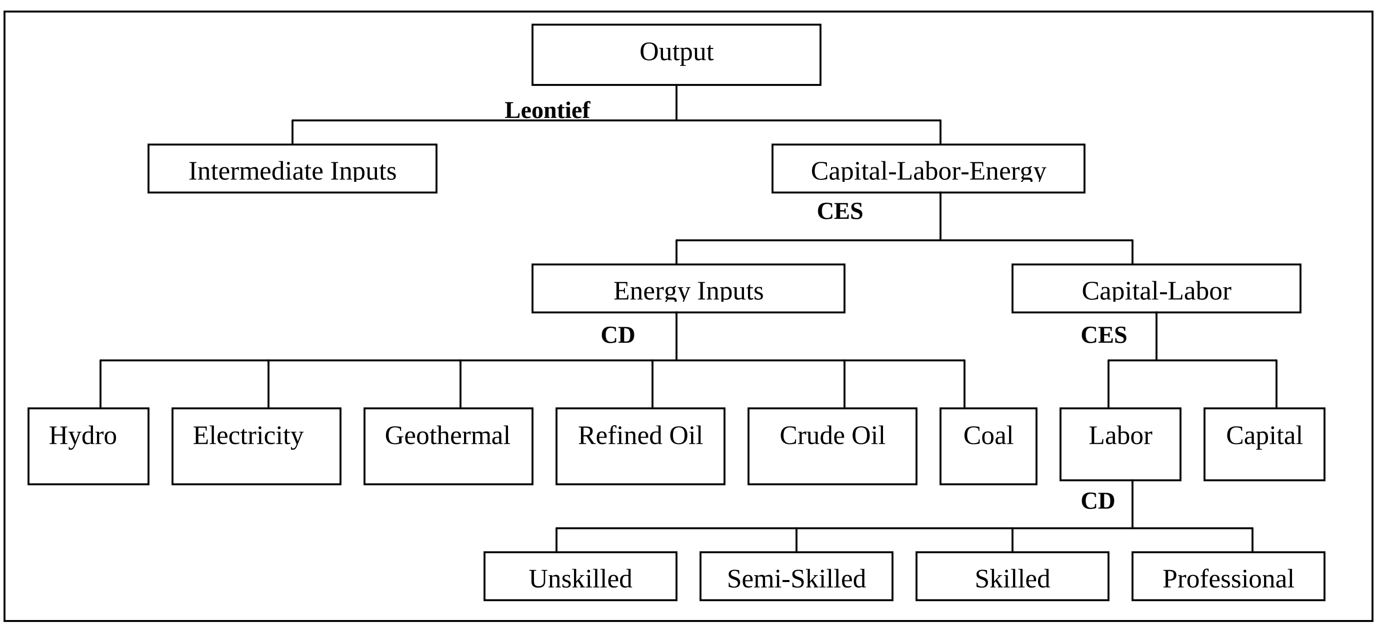


Figure 5b. Production Structure of the Electricity Sector

4.3 Carbon Taxes and Government Revenue

Carbon emissions are endogenous in the system and computed by using carbon specific fuel coefficients multiplied by the actual fossil fuel use of each sector:

$$Carbon\_emission_j = \varepsilon_j \sum_i \psi_j \cdot En\_input_{ji} \tag{1}$$

Where $carbon\_emission_j$ is the total carbon emissions of fuel j; ε_j is the carbon emission coefficient of fuel j; ψ_j is the physical conversion coefficient of fuel j; and En_input_{ji} is the intermediate energy input j used by sector i.

Government revenue is generated from direct income taxes on households and firms; indirect taxes on goods and services; and tariffs. The imposition of carbon tax results in an additional government revenue represented by ctxrev.

$$ctxrev = \sum_i \sum_j tc \cdot \varepsilon_j \cdot \psi_j \cdot En\_input_{ji} \tag{2}$$

Where ctxrev is the carbon tax revenue; tc is the carbon tax; ε is the fuel emission coefficient of fuel j; ψ_j is the physical conversion coefficient of fuel j; and En_input_{ji} represents the intermediate energy input j used by sector i.

Following Burniaux et al. (1992) and Zhang (1998), given the government revenues by kind of fuel j, the carbon tax can then be converted into fuel-specific advalorem tax rate, through the ratio of government fuel-specific revenues to the total values of domestic absorption of the fuel given by the following equation:

$$adtx_j = \frac{tc \cdot \varepsilon_j \sum_i \psi_j \cdot En\_input_{ji}}{PD_j \cdot D_j + PIM_j \cdot IM_j - Pl_j \cdot EX_j} \tag{3}$$

Where $adtx_j$ is the per fuel advalorem tax rate; PD_j is the domestic price of fuel j; D_j is domestic demand for fuel j; PIM_j is the import price of fuel j; IM_j is the import quantity of fuel j; Pl_j is the local price of fuel j; EX_j is the export quantity of fuel j.

The computed per fuel advalorem tax rate can then be applied to the domestic price of fuel expressed as:

$$PC_j = (1 + adtx_j) \cdot Pq_j \tag{4}$$

Where PC_j represents the composite price of fuel j with carbon tax; and Pq_j is the composite price of fuel j.

4.4 Poverty Measure

Poverty is measured through Foster-Greer-Thorbecke (FGT) P_α class of additively decomposable measures (Foster, Greer and Thorbecke 1984). In general, the FGT poverty measure is:

$$P_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{z - y_i}{z}\right)^\alpha, \tag{5}$$

Where α is the poverty aversion parameter; n is the population size; q is the number of people below the poverty line; y_i is income; and z is the poverty threshold.[25]

Poverty indices are calculated before and after a policy simulation using the actual distribution of income in the Family Income and Expenditure Survey (FIES). The FGT poverty measure depends on the values that the parameter α takes. At α = 0, the poverty headcount is calculated by accounting for the proportion of the population that falls below the poverty threshold. At α = 1, the poverty gap measures how far, on average, the poor are from the poverty threshold. Finally, at α = 2, the poverty-severity index is revealed. The severity index is more sensitive to the distribution of income among the poor as more weight is given to the poorest below the poverty threshold. This is because the poverty-severity index corresponds to the squared average distance of income of the poor from the poverty line, giving more weight to the poorest of the poor in the population.

Essentially, the changes in the FGT indices (after a policy simulation) are influenced by changes in household income and consumer prices, which affect the nominal value of the poverty line.

There are six Representative Household Groups (RHGs) in the Social Accounting Matrix (SAM), which are classified as follows: (1) government workers; (2) professionals; (3) sales workers; (4) agricultural workers; (5) blue-collar industrial workers; and (6) other households (not elsewhere classified). However, merely using the RHGs in the SAM to assess the household poverty impacts arising from a policy shift is not adequate. To address this, the year 2000 Family Income and Expenditure Survey (FIES) was utilized. To ensure consistency among the RHGs in the SAM and the respondents in the FIES, the households in the latter were categorized by using the household characteristics found in the former. Thus, this involved a mapping of household attributes between the SAM and the FIES.

The CGE model generates the economic, sectoral, volume and price effects of the intended policy simulation. Then, the change in disposable income and the price of the household consumer basket (weighted consumer prices) of the six RHGs in the CGE model is applied to all households with the same characteristics in the FIES. This then allows for the possibility of capturing the changes in individual household poverty

[25] The poverty threshold is equal to the food plus the non-food threshold, where threshold is defined as the cost of basic food and non-food requirements.

characteristics through Foster, Greer, and Thorbecke's (FGT) class of poverty measures. There is no feedback mechanism between the CGE model and the household module[26].

4.5 Model Closure

A CGE model is a collection of equations and variables that depict a certain economy. Solving the model requires imposing economic assumptions based on the perception of how the economy behaves and by choosing the equilibrating mechanisms that govern the structure of the model. Essentially, five model closure rules are used in this study.

Current Account Balance: The current account balance is fixed. This is analogous to the assumption of constant foreign savings. Sectoral exports and imports however, are not fixed, thus they respond to changes in the relative price ratio between Pe and Pl, which is the real exchange rate. The nominal exchange rate is fixed.

*Government Account Balance**:*** The government account balance is retained in the model. With this, all simulations employ equal yield scenarios using direct income tax as a compensatory measure. The government expenditure is held fixed in all simulations.

Carbon Tax Revenue : The generated carbon tax revenue is recycled back into the economy by decreasing direct income taxes paid by households. This is to incorporate the 'double dividend' argument that carbon taxes may lead to both a cleaner environment and a less distortionary tax system, thereby increasing welfare (Bovenberg and de Mooij 1994; Bovenberg and Goulder 1996). Since lump-sum transfers are generally less welfare-improving under second best conditions[27], the generated carbon tax revenue is used to reduce household direct income taxes. In an alternative simulation, the carbon tax revenue is recycled by reducing indirect taxes on goods and services.

Savings-Investment Balance: The savings-investment balance is fixed. Total investment is determined through the accumulated savings within the economy.

Labor Marke: The labor market assumes a neo-classical closure where wages adjust to ensure labor demand equals labor supply. On the other hand, a Keynesian closure is utilized for sensitivity analysis where the labor market equilibrium is dropped to allow for unemployment. Wages are held fixed in this type of closure.

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[26] The literature on CGE macro-micro model acknowledges that this methodology involves a strong assumption. Thus, it remains an open question on whether the linked model is fully coherent (See Lofgren, Robinson and El Said 2003; Bourguinon, Robilliard and Robinson 2002)

[27] See Bovenberg and de Mooij (1994); Bovenberg and Goulder (1996).

5. POLICY SIMULATIONS AND ANALYSES OF RESULTS

5.1 Definitions of Policy Simulations

Four counterfactual policy simulations were undertaken:

Sim_ 1: Actual tariff reductions between the years 2000 and 2006 using changes in average nominal tariff rates. Foregone tariff revenue is compensated by an increase in household income taxes.

Sim_2: Simulation 1 and a 100 peso carbon tax per ton of carbon emissions to reduce carbon emissions by approximately one per cent. The additional revenue generated from carbon tax is recycled through a decrease in household income taxes.

Sim_3: Simulation 2 with additional revenue generated from carbon tax being recycled by reducing indirect tax on goods and services.

Sim_4: Simulation 2 with Keynesian closure

All simulations, with the exception of simulation 3 entailed the use of a compensatory tax applied uniformly to all households That is, any loss in government revenue due to tariff reductions is compensated endogenously (*ntaxr*) by an increase in income taxes. Similarly, an increase in government revenue as a result of the carbon tax results in a reduction in income tax rates for all households.

$$
\begin{aligned}
Ydh_h &= Yh_h \times [1 - dtxrh_h \times ntaxr] \\
\mathrm{dtxrev_g} &= \sum_{h=1}^{6} (dtxr_h \times Yh_h \times ntaxr)
\end{aligned}
\tag{6}
$$

Where Ydh_h is the disposable income of Household h; Yh_h is the income of Household h; $dtxrh_h$ is the income tax rate for Household h; ntaxr is an endogenous variable that adjusts the income tax rate of Household h; and $dtxrev_g$ is the government revenue from household income taxes.

5.2 Simulation 1: Tariff Reductions between 2000 and 2006

Macro Effects: Tariff reductions undertaken by the Philippine government between the years 2000 and 2006 led to a 0.34 per cent decline in the local price of imported products (Table 6), resulting in a 0.24 per cent increase in imports. With this, consumer prices fell by 0.3 per cent, prompting a minimal increase (0.01 per cent) in consumption. Likewise, tariff reductions reduced the price of intermediate inputs, resulting in a 0.25 per cent dip in the domestic cost of production, and a real exchange rate depreciation (0.15 per cent). This enhanced the competitiveness of Philippine exports in the world market, resulting in a 0.23 per cent increase in exports as producers reallocated towards the international market. As a result, allocation for domestic sales fell by 0.8 per cent. However, overall imports outpaced the increase in exports as tariff reductions brought about cheaper imported products effectively crowding out locally-produced goods. In spite of this, the economy-wide output, real GDP, and welfare increased marginally by 0.004, 0.0006 and 0.001 per cent respectively.

Energy and Carbon Emissions: Tariff reductions brought about a 0.12 per cent increase in carbon emissions as the fall in local import prices induced firms to substitute local energy inputs with cheaper imported alternatives. Indeed, the demand for oil and coal increased, while the demand for electricity and indigenous sources such as natural gas, geothermal, and hydro power fell.

Table 6. Economy-wide Results for Sim_1 and Sim_3 (in percentage change)

	Sim_1	**Sim_2**
Overall nominal tariff rate	-5.27	-5.27
Import prices in local currency	-0.34	-0.34
Consumer prices (Over-all)	-0.30	-0.18
Local cost of production	-0.25	-0.33
Real exchange rate change	0.15	0.13
Import volume	0.24	0.49
Export volume	0.23	0.49
Domestic production for local sales	-0.08	-0.20
Consumption (composite) goods	0.01	-0.02
Overall output	0.004	-0.001
Real GDP	0.0006	0.007
Over-all Welfare (Equivalent variation)	0.001	0.039
Carbon Tax (per ton of carbon emissions)	-	100
Carbon Emissions	0.12	-1.07
Demand for:		
Oil	0.04	-0.13
Coal	0.36	-3.87
Natural Gas	-0.11	0.19
Electricity	-0.02	-0.33
Hydro-power	-0.14	1.15
Geothermal Power	-0.13	1.15

Source: Simulation results from the CGE Model

Sectoral Effects: Import prices fell more in agriculture compared to manufacturing as the former was more heavily protected than the latter. Because of this, import volumes for agriculture increased more than manufacturing. However, consumer prices fell more for manufacturing as imported intermediate inputs became cheaper. Exports of all sectors expanded as lower production costs, together with real exchange rate depreciation, made locally-made products relatively cheaper in the international market. In sum, tariff reductions resulted in a reallocation from agriculture and services towards the outward-oriented manufacturing sector (Table 7).

Agriculture: The fall in local import prices induced consumers to substitute cheaper imported agricultural products for their local counterparts particularly rice, corn, vegetables, and chicken as these products experienced a significant increase in import volume.[28] Because of this, total import volume in agriculture increased while domestic production fell, resulting in an output contraction for all agricultural sub-sectors.

Manufacturing: In general, tariff reductions favor the import-dependent and outward-oriented manufacturing sector as intermediate inputs become cheaper. Because of this, imports for almost all manufacturing sub-sectors, particularly food-related processing sub-sectors increases. Similarly, the fall in the costs of intermediate inputs brings the domestic costs of production down, thereby allowing firms to reallocate towards the international market. The textile and garments as well as the group "other manufacturing" sub-sector gains the most as both their output and exports increase. On the whole, total manufacturing imports and exports increased by 0.29 and 0.23 per cent respectively whereas total output expanded marginally by 0.03 per cent.

Table 7. Sectoral Effects for Sim_1 and Sim_2 (in percentage change)

Effects on Prices and Volumes										
	Price Changes (%)					**Volume Changes (%)**				
SECTORS	**δpm_i**	**δpd_i**	**δpq_i**	**δpx_i**	**δpl_i**	**δm_i**	**δe_i**	**δd_i**	**δq_i**	**δx_i**
SIMULATION 1										
Agriculture	-1.14	-0.23	-0.28	-0.22	-0.28	1.19	0.23	-0.14	-0.06	-0.12
Manufacturing	-0.37	-0.31	-0.35	-0.18	-0.35	0.29	0.23	-0.12	0.06	0.03
Services	-	-0.20	-0.18	-0.19	-0.18	-0.31	0.22	-0.03	-0.02	-0.02
SIMULATION 2										
Agriculture	-1.14	-0.29	-0.34	-0.28	-0.34	1.54	0.56	0.31	0.38	0.32
Manufacturing	-0.37	-0.37	-0.34	-0.21	-0.34	0.48	0.50	0.11	0.28	0.27
Services	-	-0.30	-0.28	-0.28	-0.28	0.43	0.35	-0.61	-0.54	-0.57

Source: Simulation results from the CGE Model
Notes:
δ - change; i - sector; pm_i- import (local) prices; pd_i - Domestic prices (with tax); pq_i - composite commodity prices; px_i - output prices; pl_i - local prices (without tax); m_i – imports; e_i – exports; d_i - domestic sales; q_i - composite commodity; x_i - total output

Service: The service sector appears to benefit less from tariff reductions as the reallocation of agricultural and manufacturing producers towards the international market brings about reduced activity in the domestic market. Because of this, the entire sector's

[28] However, it should be noted that their import volumes are almost nil at the base, hence they do not greatly affect the agricultural trade balance.

output decreased marginally by 0.02 per cent despite the 0.22-per cent increase in exports.

Table 8. Changes in Value Added for Sim_1 and Sim_2 (in percentages)

	VALUE ADDED				
	Volume	**Price**			
SECTORS	**$\delta Kleva_i$**	**$\delta Pkleva_i$**	**$\delta Pklva_i$**	**$\delta Peva_i$**	**$\delta r_{i,}$**
SIMULATION 1					
Agriculture	-0.12	-0.15	-0.15	-0.23	-0.23
Manufacturing	0.04	-0.05	-0.01	-0.24	0.03
Services	-0.02	-0.13	-0.12	-0.24	-0.16
Nominal Factor Returns:					
Capital					-0.10
Over-all Wage					-0.06
Unskilled Wage					-0.10
Semi-skilled Wage					-0.04
Skilled Wage					-0.04
Professional					-0.06
SIMULATION 2					
Agriculture	0.32	-0.19	-0.19	0.01	0.11
Manufacturing	0.23	-0.09	-0.15	0.18	0.08
Services	-0.50	-0.25	-0.28	0.12	-0.12
Nominal Factor Returns:					
Capital					-0.01
Over-all Wage					-0.49
Unskilled Wage					-0.37
Semi-skilled Wage					-0.41
Skilled Wage					-0.46
Professional					-0.77

Source: Simulation results from the CGE Model

Notes:
δ - change; Kleva: capital-labor-energy value added; PKleva: price of capital-labor-energy value added; PKlva: price of capital-labor value added; Peva: price of energy value added; r: return to capital.

Value Added: The price of the capital-labor-energy value added (PKLEVA), price of capital-labor value added (PKLVA), and the price of energy value added (PEVA) declined for the whole economy (Table 8). This is because: (a) the fall in import tariffs brought about cheaper imported energy inputs; and (b) the reduction in domestic costs of production, coupled with the reduction in agricultural and services output brought about lower nominal factor returns.

Over-all nominal return to capital decreased by 0.1 per cent although nominal returns to capital in the manufacturing sector increased by 0.03 per cent, while over-all nominal labor wage rate dropped by 0.06 per cent. In general, the fall in over-all return to capital is due to the contraction in output of both agricultural and services as a result of declining profitability. On the other hand, the nominal wage rate for all labor types decreased as well since the output reduction in agriculture and manufacturing sectors allowed both sectors to release laborers which resulted in an excess supply of labor in the labor market. Thus, nominal wages fall albeit modestly in order to restore labor market equilibrium. Labor demand for both agriculture and services fell, resulting in a labor reallocation towards the manufacturing sector. Overall nominal wages and return to capital fell in the economy, although the return to capital in the manufacturing sector increased by 0.03 per cent as the sector gained from output and export expansion.

Table 9. Changes in Household Income, Disposable Income and Cost of Commodity for Sim_1 and Sim_2 (in percentages)

	Sim_1				**Sim_2**		
Households	**δYh_h**	**δYdh_h**	**δPc_h**		**δYh_h**	**δYdh_h**	**δPc_h**
All Philippines							
Government Workers	-0.06	-0.45	-0.29		-0.39	0.95	-0.13
Professionals	-0.06	-0.44	-0.27		-0.28	0.99	-0.10
Clerks and Sales	-0.06	-0.24	-0.31		-0.30	0.31	-0.19
Agricultural Workers	-0.07	-0.14	-0.34		-0.15	0.09	-0.24
Blue-Collar Industrial Workers	-0.06	-0.19	-0.32		-0.32	0.12	-0.23
Other Households (nec)	-0.04	-0.23	-0.29		-0.24	0.40	-0.15

Source: Simulation results from the CGE Model

Notes:
δ - change; Yh_h - Income of household h; Ydh_h - Disposable income of household h; δPc_h - cost of household specific consumption basket

Household Income and Consumer Prices: Table 9 shows the changes in the income (δYh_h), disposable incomes of households (δYdh_h) and the cost of household specific consumer basket (δPc_h). All households experienced a reduction in income as nominal wages and return to capital fell. Similarly, all households experienced a much higher reduction in disposable income which varied by occupation sector. For instance, government workers and professional-headed households experienced a much higher reduction in disposable income compared with agricultural-dependent households. This is because the impact of increasing income taxes to replace the foregone government tariff revenue imposes a heavy burden among government workers and professionals more than any other household. Being employed in the formal sector, these households bear the burden of higher income taxes relative to other households, particularly agricultural and blue collar industrial workers pays relatively lower income taxes.

Nevertheless, tariff reductions bring about a fall in consumer prices which translates to a fall in the cost of all households specific consumer basket (δPc_h), and hence a cheaper cost of living for all households. Agricultural and blue collar industrial workers experienced the highest reduction in the cost of consumer basket relative to other households owing to a higher share of primary agricultural products in their consumption basket which were heavily protected at the base.

Poverty and Welfare: The changes in poverty indices (headcount, gap, and severity), which depend on the changes in disposable incomes of households (δYdh_h) and the cost of household specific consumer basket (δPc_h) are presented in Table 10. The national poverty headcount marginally decreased by 0.14 per cent, while the poverty gap and severity of poverty decreased by 0.33 and 0.44 per cent respectively. The reduction in the poverty gap and severity implies that the poorest of the poor have become relatively better off. In general, the reduction in poverty indices implies that the price reduction effect outweighed the disposable income reduction effect of the tariff reductions. All poverty indices decreased for all households except for government workers and professional-headed households whose poverty index remained unchanged. However, the poverty gap and severity of poverty worsened for these two household groups as the reduction in their disposable income is higher than the reduction in the cost of their consumer basket (Table 9). Overall household welfare in the Philippines (measured through equivalent variation) increased marginally.

Table 10. Changes in Poverty Indices and Welfare for Sim_1 and Sim_2 (in percentages)

	Sim_1				**Sim_2**			
	Poverty Index			**Welfare**	**Poverty Index**			**Welfare**
Households	**Headcount**	**Gap**	**Severity**	**EV***	**Headcount**	**Gap**	**Severity**	**EV***
All Philippines	-0.14	-0.33	-0.44	0.001	-0.59	-0.84	-1.03	0.039
Government Workers	-	0.43	0.41	-0.002	-0.70	-2.71	-2.87	0.011
Professionals	-	0.44	0.69	-0.002	-3.04	-3.00	-3.88	0.011
Clerks and Sales	-0.12	-0.19	-0.25	0.001	-0.52	-1.49	-1.71	0.005
Agricultural Workers	-0.12	-0.37	-0.48	0.002	-0.41	-0.63	-0.82	0.003
Blue-Collar Industrial Workers	-0.20	-0.37	-0.42	0.001	-0.71	-0.96	-1.14	0.003
Other Households (nec)	-0.28	-0.16	-0.20	0.001	-1.12	-1.47	-1.69	0.006

Notes: EV = Equivalent Variation

5.3 Simulation 2: Tariff Reductions between 2000 and 2006 and a Carbon Tax to Reduce Carbon Emissions by One Per Cent

Macro Effects: The macroeconomic effects (Table 6) of Simulation 2 was a marginal reduction in consumption and overall output (0.02 and 0.001 per cent respectively). The reduction in output stemmed from a higher import demand (0.49 per cent), and lower domestic production (0.2 per cent) resulting from the increase in relative energy prices.

Nonetheless, the price effect of the tariff reductions still dominated, although by a lesser amount (-0.18 per cent compared to -0.30 percent in simulation 1) — as the fall in local import prices was partially offset by the carbon tax. The real exchange rate still depreciated, implying that on average, cheaper intermediate inputs as a result of tariff reductions, and a higher fall in wages and price of capital caused Philippine-made products to be relatively cheaper in the international market. Thus, exports increased by 0.49 per cent which is higher than 0.26 per cent in Simulation 1 in spite of the imposition of carbon tax.[29]

Energy and Carbon Emissions: Imposing a 100 peso carbon tax (per ton of carbon emissions) is enough to reduce carbon emissions by one per cent. As a result, the demand for carbon intensive energy inputs such as coal and oil decreased. The decrease in coal demand was higher because coal is more carbon-intensive than oil. Likewise, the demand for electricity fell as it uses coal and oil intensively. On the other hand, the demand for less carbon-intensive energy like natural gas and carbon-free energy such as hydro-power and geothermal power increased as the electricity sector, to some extent, substituted carbon-intensive energy with less carbon-intensive sources and carbon-free energy inputs.

Sectoral Effects: Tariff reductions coupled with a carbon tax resulted in a reallocation from services towards agriculture and manufacturing (Table 7). Once again, the domestic price reduction in manufacturing was higher compared to agriculture and services as intermediate goods became cheaper. The imposition of a carbon tax did not result in an increase in the composite prices of oil and coal (although both their prices are higher relative to simulation 1) as the impact of tariff reductions outweighed the cost impact of the carbon tax.

In this simulation, both agriculture and industry output expanded, while services output contracted. The expansion in output resulted from the producers' ability to substitute capital and labor for energy inputs. Since the share of energy in the total capital-labor-energy value added of firms was minimal, the impact of carbon tax on the production structure of firms was not detrimental.

Agriculture: The agricultural sector is somewhat immune from the imposition of carbon tax since it uses minimal energy. The output of all agricultural sub-sectors

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[29] It should also be noted that the closure rule of a fixed current account balance also contributed to a higher export volume in Simulation 2. A fixed current account balance assumes that there is no free lunch. That is, any increase in imports worsens the balance of payments (BOP), and must be compensated by either an increase in exports or foreign borrowing. Since borrowing is fixed, exports have to increase to keep BOP = 0.

increased as firms substituted capital and labor for energy inputs. Similar to the first simulation, the fall in local import prices induced consumers to substitute cheaper imported agricultural products for their local counterparts. However, domestic production increased as labor wages and price of capital became relatively cheaper compared with the first simulation. Hence, this allowed the agricultural sector to hire more labor and increase domestic production.

Manufacturing: Carbon taxation did not significantly affect the manufacturing sector's performance as sub-sectors such as wood, chemicals, textiles, "other manufacturing", and all food-related manufacturing still continued to enjoy an increase in output and exports. This stemmed from greater access to cheaper intermediate inputs that resulted in a lower cost of production in spite of the carbon tax.

On the other hand, carbon taxation brought about varying impacts among the energy-producing sectors. The price of coal, electricity, hydro-power, and geothermal sources fell while the price of natural gas increased. This is because the impact of tariff reductions greatly influenced the variation in energy prices. For instance, the fall in local import prices for coal and oil (0.65 and 0.26 per cent respectively) resulted in lower consumer prices for both sectors relative to the base. In contrast, having no imports and thus not imposed any import tariff, the price of natural gas increased (though still cheaper in relative terms when compared with the price of oil and coal) as the sector bore the full burden of the carbon tax. However, the price of non-carbon energy inputs (electricity, hydro, and geothermal) became relatively cheaper since they were exempted from the carbon tax.

The output of all fossil fuels sectors decreased, except natural gas whose output increased. This is expected as natural gas is less carbon-intensive compared to oil and coal. Furthermore, being part of a market-driven policy, carbon tax induces producer substitution from carbon-intensive fuels to less carbon-intensive energy, and towards carbon-free inputs. The output of the electricity sector decreased as it bore the greatest impact of the carbon tax, being the foremost user of carbon-intensive inputs.

Value Added: Table 8 presents the changes in value added for Simulation 2. The price of the energy value added (PEVA) increased as a result of the carbon tax, whereas the price of capital-labor-energy value added (PKLEVA) fell owing to the reduction in the price of capital-labor value added (PKLVA). The fall in the nominal price of capital and wages (0.01 and 0.49 per cent respectively) allowed firms to substitute both capital and labor for energy. As a result, the total capital-labor-energy composite increased for most sectors.

Labor demand increased for both agriculture and industry, but fell for services. The increase in agriculture and industry output allowed both sectors to absorb laborers that were laid off in the contracting services sector. Among all sectors, the group "other services" experienced the largest reduction in labor utilization, while the natural gas sector, due to its output expansion, realized the largest increase in labor demand. Once again, nominal wages declined as the output reduction in services allowed the sector to release laborers which results in an excess supply of laborers in the labor market. Thus, nominal wages fall marginally in order to restore labor market equilibrium.

Household Income and Consumer Prices: All households experienced a decrease in income (δYh_h) due to the reduction in nominal wages and return to capital (Table 9) but an increase in disposable income (δYdh_h) as the generated carbon tax revenue, in lieu of the household income tax, was used to replace the foregone tariff revenue. Furthermore, the generated carbon tax revenue was higher than the amount of foregone tariff, resulting in a reduction in household income taxes. As a result, the disposable income of all households increased relative to the first simulation. Agricultural workers and blue collar industrial workers experienced the lowest increase in disposable income as they benefited less from the carbon tax revenue recycling scheme owing to their smaller income tax payments at the base.

The cost of household specific consumer basket (δPc_h), fell for all households as consumer goods became cheaper – the price impact of the tariff reductions offset the cost impacts of the carbon tax. Both agricultural workers and blue collar industrial workers experienced the highest reduction in their cost of consumer basket when compared with other households. This can be traced to their higher consumption of primary products and minimal energy goods thus effectively protecting them from the higher cost of energy due to the carbon tax. Over-all, both agricultural workers and blue collar industrial workers benefited less from the carbon tax revenue recycling scheme due to lower tax payments at the base, but they nonetheless experienced the largest reduction in household specific consumer basket as they consume more primary products and minimal energy.

Poverty and Welfare: The national poverty headcount decreased by 0.59 per cent, while the poverty gap and severity of poverty decreased by 0.84 and 1 per cent respectively (Table 10). All poverty indices decreased for all households particularly government workers and professional-headed households. In contrast to the first simulation, the poverty indices for government workers and professional-headed households decreased as they benefited from the reduction in income tax.

Similarly, the increase in household welfare was higher than Simulation 1. Once again, both government workers and professional-headed households experienced the largest increase in welfare while agricultural workers and blue-collar industrial workers gained the least.

5.4 Simulations 3 and 4: Sensitivity Analysis on Alternative Revenue Recycling Scheme and Labor Market Closure)

Table 11 shows the changes in household income (δYh_h), disposable income (δYdh_h) and cost of household specific commodity basket (δPc_h) for simulations 3 and 4. Simulation 3 simulates the impact of tariff reductions between the years 2000 and 2006 coupled with a 100 peso carbon tax, with the additional carbon tax revenue being recycled to reduce indirect taxes on goods and services. While simulation 4 assesses the impact of tariff reductions between the years 2000 and 2006 with the additional carbon tax revenue being recycled to reduce direct taxes imposed on households while at the same time allowing for unemployment.

Table 11. Changes in Household Income, Disposable Income and Cost of Commodity Basket for Sim_3 and Sim_4 (in percentages)

	Sim_3				**Sim_4**		
Households	**δYh_h**	**δYdh_h**	**δPc_h**		**δYh_h**	**δYdh_h**	**δPc_h**
All Philippines							
Government Workers	-0.11	-0.11	-0.31		-0.61	0.62	-0.14
Professionals	-0.07	-0.07	-0.28		-0.50	0.68	-0.11
Clerks and Sales	-0.08	-0.08	-0.34		-0.52	0.04	-0.18
Agricultural Workers	-0.03	-0.03	-0.39		-0.38	-0.16	-0.22
Blue-Collar Industrial Workers	-0.09	-0.09	-0.37		-0.55	-0.15	-0.21
Other Households (nec)	-0.07	-0.07	-0.31		-0.40	0.19	-0.15

Source: Simulation results from the CGE Model

Notes: δ - change; Yh_h - Income of household h; Ydh_h - Disposable income of household h; δPc_h - cost of household specific consumption basket

Essentially, the direction of results for simulation 3 and 4 is similar but different in magnitude when compared with simulation 2. Households' income (δYh_h) fall the most in simulation 4 relative to simulation 2 and 3. This is not surprising since simulation 4 allows for rigidity in the labor market to account for possible unemployment. Similar to other simulations, all households experienced a reduction in income (δYh_h) due to lower nominal factor returns. The changes in household disposable income (δYdh_h) varied across households in simulation 4. All households with the exception of agricultural workers and blue-collar industrial workers experienced a gain in disposable income. This is because both agricultural workers and blue-collar industrial workers benefited the least from the carbon revenue recycling scheme owing to their smaller income tax payments at the base (which is the basis of the revenue recycling scheme). Nonetheless, the reduction in their disposable income is lower when compared with the reduction in income. Moreover, the cost of household specific consumer basket (δPc_h) fall the most for these two household groups owing to their higher consumption of primary agricultural products and minimal energy.

On the other hand, the fall in household income (δYh_h) is exactly the same as the fall in disposable income (δYdh_h) in simulation 3. This is because the additional carbon tax revenue was recycled to reduce indirect taxes on goods and services instead of reducing household income taxes. As a result, the cost of household specific consumer basket (δPc_h) fall the most in simulation 3 when compared with all other simulations.

Table 12 shows the changes in poverty headcount and equivalent variation for simulation 3. In general, all household groups experienced a reduction in poverty headcount and welfare improvements. A comparison of all simulation results show that: First, using additional revenue generated from the carbon tax to reduce indirect taxes on goods and services results in less poverty reduction. Indeed, the reduction in poverty indices across households in simulation 3 is lesser compared with simulation 2. Nonetheless, poverty indices still fall in simulation 3 due to the larger reduction in household specific consumer basket relative to disposable income. Second, the improvement in welfare is less in simulation 3 than in simulation 2. Third, the reduction in poverty indices and improvement in welfare in simulation 3 is slightly higher when compared with simulation 1.

Table 12. Changes in Poverty Headcount and Welfare for Sim_3 and Sim_4 (in percentages)

	Simulation 3			**Simulation 4**	
Households	**Poverty Headcount**	**EV***		**Poverty Headcount**	**EV***
All Philippines	-0.43	0.016		-0.12	0.022
Government Workers	-0.70	0.002		-0.69	0.008
Professionals	0.00	0.002		-1.67	0.008
Clerks and Sales	-0.23	0.003		-0.18	0.002
Agricultural Workers	-0.42	0.004		-0.04	0.001
Blue-Collar Industrial Workers	-0.59	0.003		-0.05	0.001
Other Households (nec)	-0.40	0.002		-0.40	0.003

Notes: EV = Equivalent Variation

Similarly, table 12 shows the changes in poverty indices and household welfare of simulation 4. By and large, the direction of changes in simulation 4 are similar with that of simulations 2 and 3 though lesser in magnitude. The reduction in poverty indices and equivalent variation is roughly half-less in simulation 4 when compared with simulation 2. This is not surprising as the former simulation allows for rigidity in the labor market. Thus, allowing for unemployment results in a higher fall in income (δYh_h in Table 11) among households especially those who become unemployed. Similar to the results in simulation 2, both professionals and government workers gain the most while agricultural and blue collar industrial workers gain the least in terms of poverty reduction.

6. CONCLUSIONS

Tariff reductions bring about cheaper imported inputs driving the domestic cost of production down, benefiting the outward-oriented and import-dependent manufacturing sector. Simulation results show that the tariff reductions undertaken between the years 2000 and 2006 reduced the cost of imported oil and coal products, thereby resulting in a marginal increase in carbon emissions.

In this paper, four policy simulations were undertaken to analyze the possible economic cost of reducing carbon emissions during the ongoing trade liberalization process. The economic cost of reducing carbon emissions by one per cent is marginal as the price effect of a tariff reduction outweighs the cost impact of the carbon tax. Except for the energy sector, in which output falls, the simulation results show that a 100 peso carbon tax per ton of carbon emissions is not detrimental to production as the share of energy in the total value added is minimal.

All poverty indices (headcount, gap, and severity) fall as a result of tariff reduction. The national poverty headcount fall additionally across all carbon tax simulations especially whenever the additional generated carbon tax revenue is used to compensate for the foregone tariff revenue, and to reduce household income taxes. Similarly, welfare increases as households experience a decrease in the cost of their consumer basket as the price reducing impacts tariff reduction outweigh the cost increasing effect of the carbon tax.

Although these results appear to be robust in the Philippine case, it should be noted that the model suffers from a few caveats that needs to be considered in future extensions of the research. First, the political economy of energy policy in the Philippines which is primarily controlled by energy industry lobbyers, the government's energy regulatory commission and consumer interest groups was not considered. Secondly, the model which relies on prices to determine equilibrium in the energy market failed to consider dynamic issues and existing energy regulatory regimes in place. For instance, the model was not able to account for the increasing share of fossil fuels (coal, oil and natural gas) in the production of electricity especially in the coming years as stated in the Philippine energy plan owing to data constraints. Moreover, the production structure of the model assumes a Cobb-Douglas function among energy inputs which assumes unitary substitution among energy inputs.

Taking these caveats aside, the simulation results in this paper show that carbon taxes not only compensate for the foregone tariff revenue, but also reduce poverty and increase welfare whenever the generated carbon tax is used to reduce income taxes. In conclusion, imposing a carbon tax during the ongoing trade liberalization process appears to be a sensible alternative that may satisfy both the economic and environmental objectives of the country.

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APPENDIX 1

Table A1. Production and Commodity Accounts

Agriculture	1	PALAY (RICE)
	2	COCONUT
	3	FRUITS
	4	SUGAR
	5	VEGETABLES
	6	OTHER CROPS
	7	HOGS AND LIVESTOCK
	8	CHICKEN
	9	FISHING
	10	FORESTRY
Manufacturing	11	MINING
	12	COAL**
	13	OIL**
	14	NATURAL GAS**
	15	MEAT PROCESSING
	16	MILK AND DAIRY
	17	MEAT AND FISH CANNING
	18	GRAINS AND SUGAR MILLING
	19	FOOD PROCESSING
	20	ALCOHOLIC AND NON-ALCOHOLIC BEVERAGES
	21	TEXTILE AND GARMENTS
	22	WOOD
	23	CHEMICALS
	24	OTHER MANUFACTURING
	25	CONSTRUCTION
	26	ELECTRICITY**
	27	GEOTHERMAL**
	28	HYDRO-POWER**
	29	WATER
Services	30	TRANSPORT
	31	WHOLESALE AND RETAIL TRADE
	32	BANK AND INSURANCE
	33	PROFESSIONAL SERVICES
	34	OTHER SERVICES
	35	PUBLIC SERVICES

Source: Based on the constructed 2000 SAM

Notes: ** = Energy Sectors

APPENDIX 2

ECONOMIC STRUCTURE AT THE BASE

Table A2.1 shows the economic structure of the Philippine economy based on the Social Accounting Matrix (SAM). In general, the pattern of trade confirms the dominance of the manufacturing sector as it accounts for 92 per cent of total exports, outperforming both services and agricultural sectors with six and two per cent share respectively. Indeed, total agricultural exports contribute only five per cent to total exports even when agriculture-related food processing is accounted for. The principal industrial export is the sub-sector “other manufacturing” (composed of semi-conductors, electronics, appliances, and machinery) which accounts for 77 per cent of total exports, followed by textile and garments, and food canning at 8 and 2.5 per cent respectively. These sub-sectors are the most export-intensive among all, allocating a significant part of their output to the international market (other manufacturing – 91 per cent; textile and garments – 42 per cent; and canning – 27 per cent). On the other hand, the least export intensive sub-sectors are mostly in agriculture, with the exception of the fruits sub-sector.

Similarly, 87 per cent of total imports accrue to the manufacturing sector, with the remainder going to agriculture and services with 2 and 11 per cent respectively. The significant share of the manufacturing sector in total imports stems from the low value-added, import-intensive and assembly-type operation nature of the manufacturing sector, particularly in semi-conductors, chemicals, and textiles and garments sub-sectors. The highly import-intensive sectors are “other manufacturing”, coal, oil, chemicals, and mining.

On the other hand, both agriculture and services have a higher capital-labor-energy (KLE) to output ratio compared with industry (76, 68, and 49 per cent respectively). In spite of this, electricity stands out as the highest user of capital-labor-energy value-added (95 per cent) owing to its high capital and energy-intensive production structure. The highly energy-intensive sub-sectors, defined in terms of energy to output ratio are oil (75 per cent), electricity (28 per cent), and natural gas (14 per cent). Among the non-energy sectors, mining as well as transport are the most energy-intensive with 13 and 12 per cent energy to value added ratio respectively.

The agricultural sector generally has a higher capital-labor value added (this means KLVA divided by X – See Table A2.1) to output ratio compared to services and manufacturing, although its contribution to the overall capital and labor value added in the economy is relatively small. In fact, agriculture only contributes 13 per cent of the domestic labor and capital value added (GDP), whereas services and manufacturing contribute 49 and 38 per cent respectively. This stems from the highly labor-intensive nature of the agricultural sector, particularly in sub-sectors such as rice, corn, vegetables, and coconut. Hence, in general, labor intensity is uniformly higher in agriculture with the exception of fishing.

Table A2.1. Economic Structure at the Base

SECTORS	TRADE				PRODUCTION				
	Exports,%		Imports,%						
	Share	Export as a percentage of sectoral output	Share	Import as a percentage of composite commodity	$(KLEVA/X)_i$	$(KLVA/X)_i$	$(EVA/X)_i$	Value Added Share ($KLVA_i$ / KLVA)	Labor to Capital Ratio
RICE	0.001	0.01	0.1	2.0	79.5	77.7	1.8	2.6	244.3
COCONUT	0.002	0.2	-	-	89.3	88.9	0.4	0.6	146.1
FRUITS	0.5	21.6	0.2	10.9	79.3	78.7	0.6	1.5	76.4
SUGAR	-	-	-	-	74.3	69.7	4.6	0.3	95.4
VEGETABLES	0.03	2.9	0.1	8.8	81.8	81.2	0.6	0.8	149.1
OTHER CROPS	0.01	0.4	0.5	28.6	81.8	80.6	1.1	0.9	95.1
HOGS	0.002	0.1	0.1	2.2	66.0	65.5	0.5	1.8	98.0
CHICKEN	0.001	0.0	0.01	0.4	63.9	60.7	3.2	1.3	90.6
FISHING	0.3	7.9	0.01	0.3	81.3	77.4	3.8	2.8	52.3
FORESTRY	0.03	10.3	0.001	0.6	93.2	89.5	3.8	0.2	26.8
AGRICULTURE	**1.7**	**4.4**	**2.0**	**5.1**	**76.5**	**74.5**	**2.0**	**12.9**	**100.8**
MINING	0.2	16.4	0.6	39.5	75.8	63.2	12.7	0.6	43.1
COAL	-	-	0.2	83.4	64.9	58.1	6.8	0.0	57.0
OIL	0.7	11.8	5.0	50.1	89.5	14.3	75.3	0.7	100.0
NATGAS	-	-	-	-	42.0	27.6	14.4	0.0	84.6
MEAT	0.002	0.04	0.2	3.4	21.7	20.5	1.1	1.1	52.7
MILK	0.02	1.7	0.5	33.6	36.1	31.1	4.9	0.3	51.2
CANNING	1.2	27.3	0.5	14.1	34.5	30.7	3.9	1.2	34.6
MILLING	0.1	1.1	0.2	3.7	30.2	28.7	1.5	1.6	86.3
FOOD	0.2	5.3	0.5	10.1	34.8	31.6	3.2	1.2	67.4
ALCOHOL	0.04	1.4	0.2	5.7	45.5	40.4	5.1	1.0	72.2
TEXTILE	4.1	41.7	1.9	24.9	47.5	42.9	4.5	3.6	75.8
WOOD	1.0	19.7	1.0	19.3	43.9	39.3	4.6	1.7	68.4
CHEMICALS	0.6	9.2	3.9	40.6	49.3	41.1	8.2	2.2	56.7
OTHER MANUFACTURING	39.4	90.5	29.4	87.7	47.0	43.0	3.9	16.1	55.5
CONSTRUCTION	0.1	1.5	0.2	1.9	54.8	53.0	1.8	3.9	179.1
ELECTRICITY	-	-	-	-	95.0	67.7	27.3	2.8	31.3
STEAM	-	-	-	-	79.8	67.5	12.3	0.1	25.2
HYDRO SOURCE	-	-	-	-	79.8	67.6	12.3	0.1	25.3
WATER	-	-	-	-	81.4	75.3	6.1	0.3	73.4
INDUSTRY	**92.5**	**42.7**	**87.1**	**41.0**	**48.9**	**40.3**	**8.6**	**38.5**	**64.5**
TRANSPORT	1.6	10.2	4.4	24.2	66.0	53.6	12.4	7.0	52.6
WHOLESALE	1.2	5.1	0.3	1.5	68.7	65.8	2.9	13.5	59.3
BANK	0.2	1.1	0.8	4.7	78.4	76.5	1.8	11.3	18.4
PROFESSIONAL	-	-	-	-	52.4	49.8	2.6	4.8	274.0
OTHER SERVICES	-	-	-	-	61.7	55.5	6.2	3.9	191.0
PUBLIC SERVICES	-	-	-	-	74.1	72.2	1.8	8.2	-
SERVICES	**5.8**	**3.3**	**10.9**	**6.1**	**68.2**	**63.8**	**4.4**	**48.6**	**93.1**

Source: Author's calculation based on the Social Accounting Matrix

Notes: *KLEVA- Capital-Labor-Energy Value Added; KLVA- Capital-Labor Value Added; EVA- Energy Value Added; X – Output; i – Sector

Household Income Sources and Poverty Profile

Table A2.2 presents the sources of household income at the base where income generated from labor wages stands out as the main source of income. An exception would be the agriculture-dependent households which receive most of their income from capital (land and assets). However, this does not imply that capital is the main source of income for the said household group. The main reason behind this phenomenon is that the proportion of income due to capital — accruing mainly to rich agricultural households — outweighs the labor wages received by poor agriculture-dependent households. On the other hand, "other households" (whose occupation is not elsewhere classified) rely mainly on transfers from firms and government, as well as remittances from relatives working abroad.

Table A2.2. Household Income Sources at the Base

	Wage Income				Capital Income	Transfers	Remittances	Total
	Unsk	Smsk	Skl	Prof				
Government Workers	14.6	19.3	16.2	23.9	14.8	5.6	5.5	100
Professionals	9.9	12.5	10.7	18.2	35.2	4.9	8.7	100
Clerks and Sales	12.6	15.9	11.4	17.1	31.0	4.9	7.2	100
Agricultural Workers	8.9	7.8	3.7	8.0	61.1	5.4	5.1	100
Blue-collar Industrial Workers	15.3	19.1	10.1	17.3	28.4	3.1	6.6	100
Other Households (nec)*	10.6	12.9	9.2	13.8	16.7	27.7	9.2	100

Source: Author's calculation based on the SAM

Notes: Unsk – Unskilled; Smsk – Semi-Skilled; Skl – Skilled; Prof – Professional; *nec - not elsewhere classified

In the year 2000, about 34 per cent of the population of 74 million were living below the poverty threshold (Table A2.3). Across households, agricultural-dependent households are by far the poorest with a 50 per cent poverty headcount ratio. This is not surprising as poverty in the Philippines is fundamentally a rural problem where the majority of the rural population depend on agriculture. It is for this reason that the poverty gap and severity of poverty is likewise the highest among these households. In contrast, professional households are the least susceptible to poverty (7.8 per cent poverty headcount) because of a higher earning capacity.

Table A2.3. Household Poverty Profile at the Base

	Poverty Index		
	Headcount	**Gap**	**Severity**
All Philippines	33.9	10.7	4.6
Government Workers	14.2	4.0	1.7
Professionals	7.8	2.0	0.7
Clerks and Sales	17.3	4.3	1.6
Agricultural Workers	57.8	20.0	9.0
Blue-Collar Industrial Workers	26.4	7.0	2.6
Other Households (nec)*	18.4	5.0	2.0

Source: Author's calculation based on the SAM

Notes: *nec = not elsewhere classified